

**PATENT APPLICATION
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**TITLE: ADDING IN-DEVICE BATTERY CHARGING CAPABILITY TO
BATTERY-POWERED DEVICES**

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Application Serial No. 60/416,301 on 10/03/2002, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

The invention relates to recharging, maintaining the charge of, and monitoring the state of rechargeable batteries that are used in portable devices. In particular, the invention addresses the problem of providing in-device charging capability for existing battery-powered devices.

Recently, rechargeable batteries have become available in standard sizes (D, C, A, AA, AAA, 9V) for use in battery-powered devices that are designed to use disposable (non-rechargeable) batteries. When these rechargeable batteries become discharged, they must be removed from the battery-powered device and inserted into a battery charger to be recharged. After charging, the batteries must be re-inserted into the battery-powered device.

Some battery-powered devices employ rechargeable batteries that do not require removal of the battery for the purpose of re-charging. These battery-powered devices have exposed contacts for interface with a charger or they employ wireless transfer of energy from a base station charger to the battery. However, in this case, in-device recharging was an intended feature of the design of the battery-powered device.

Simply inserting standard sized rechargeable batteries into devices that have been designed for use with disposable batteries will lack this useful and convenient in-device charging capability.

BRIEF SUMMARY OF THE INVENTION

The invention described allows batteries to be recharged while inside a battery-powered device that has not been designed for in-device recharging. Typically, this includes battery-powered devices that have been designed to use disposable (non-rechargeable) batteries. In-device recharging is a more convenient way to recharge the batteries of a battery-powered device, since the device need only be placed in close proximity to a charger base station or cradle to charge, maintain charge, or monitor the state of the batteries.

The invention allows the batteries to be more easily maintained at full charge, since a battery-powered device using an embodiment of the invention may be stored or kept close to the charger while not in use. It is also possible to measure the state of charge, current, voltage, temperature, and, in general, the state of the batteries and charging system, again, without removing the batteries from the battery-powered device.

The invention provides a battery charger which comprises a wireless receiver of energy, a charging circuit, and an attachment or connection means to maintain a connection between a battery and the charging circuit. Charging is possible when an embodiment of the invention is placed in proximity to a compatible wireless transmitter of energy. Various embodiments differ slightly from each other structurally, but all provide a means for in-device battery charging.

One preferred embodiment of the invention is inserted into the battery compartment of a battery-powered device and connected to contacts of the battery-powered device

Another embodiment of the invention is a battery charger that is integrated with each battery and is in contact with the battery terminals, forming a unit that is handled and inserted into a battery-powered device the same way as would be a battery without the integrated battery charger.

In another embodiment, an in-device battery charger includes a wireless sender of data and is bi-directionally coupled to a base station that is both a wireless transmitter of energy and a wireless receiver of data, so as to obtain and use data regarding the state of the batteries or charging system.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 illustrates an embodiment of the invention, comprising: a wireless receiver of energy 11, a charging circuit 13, a connection means illustrated in the figure as an externally insulated conductor 14 to a positive terminal connector 15 and an externally insulated conductor 16 to a negative terminal connector 17.

Fig. 2 illustrates another embodiment of the invention, comprising: a battery 10, a wireless receiver of energy 11, a charging circuit 13, a connection means illustrated in the figure as an externally insulated conductor 14 to a positive terminal connector 15 and an externally insulated conductor 16 to a negative terminal connector 17 wherein the connectors are connected to the battery 10.

Fig. 3 illustrates an operation of an embodiment of the invention in a battery-powered device 18 (not part of the invention) that has a battery compartment 19 (not part of the invention) and battery connection terminals 20 (not part of the invention) to the battery-powered device 18. The figure illustrates a connection means comprising 14,15,16,17 to rechargeable batteries 10, which have been inserted into the battery compartment 19 of the battery-powered device 18. A wireless transmitter of energy 12 is shown, consistent with the typical operation of the embodiment of the invention.

DETAILED DESCRIPTION

The first and most basic embodiment of the invention is depicted by Fig. 1. A wireless receiver of energy means 11, is connected to a charging circuit means 13, which is connected to a battery via the connection means comprised of a conductor 14 to a positive terminal connector 15 and a conductor 16 to a negative terminal connector 17. When placed in close proximity to a compatible wireless transmitter or sender of energy, a rechargeable battery so connected to embodiment shown in Fig. 1 will receive an electric current capable of recharging the battery. The embodiment of the invention shown in Fig. 1, when used with a battery-powered device containing one or more rechargeable batteries, functions as an in-device battery charger.

Another embodiment, shown in Fig. 2, constitutes a battery charging device that is integrated with a rechargeable battery 10. Placing the embodiment of Fig. 2 within proximity of a wireless transmitter of energy will cause the battery to recharge or maintain its charge. The primary advantage being in-device charging that might otherwise not be possible with a particular battery-powered device. The battery-with-integrated-charger device embodiment of Fig. 2 has approximately the same physical characteristics as the battery alone, since the battery is relatively much larger than the integrated charging components. This feature allows the battery-with-integrated-charger device embodiment to replace standard sized disposable batteries in portable devices whenever the battery component 10 of the embodiment is a standard sized rechargeable battery component.

Fig. 3 illustrates a typical operation of an embodiment of the invention. An embodiment of the invention, as a charging device, is inserted into the battery compartment 19 (not part of the invention) of a battery-powered device 18 (not part of the invention). The connector 15 of the connection means of the device has been brought in contact with the positive terminal of the battery-powered device and with the positive terminal of one of the series-connected batteries. The remaining connector 17 has been attached to the negative side. The connectors in this embodiment are cap-style connectors, which, when combined with the force between the battery holder and the battery, mechanically secure the connections. A wireless transmitter of energy 12, positioned near the charging device embodiment of the invention, provides energy for producing a charging current.